



Bay DO Assessment DEQ's Near Term Plan and Looking Ahead to the 4-D Interpolator

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Discussion Guide

- Background on Virginia's Water Quality Standards and assessment process
- Overview of the DO assessment and supporting analyses Virginia has performed
- Overview of the DO assessment with the 3-D Interpolator
- Issues which may be considered looking forward

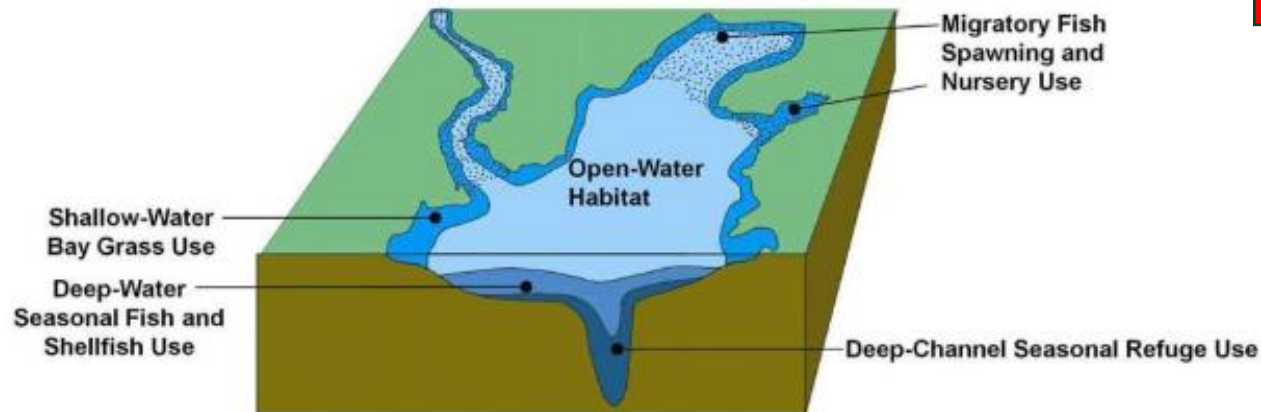
Over the past year, DEQ has done a self-examination of its Bay DO monitoring and assessment programs

Multiple drivers:

- Desire to improve monitoring programs
- Desire to incorporate all available data into Bay DO assessments
- Desire to assess all DO criteria so that the progress of TMDL implementation can be fully realized

Bay DO criteria

Bay DO criteria were developed by the CBP in the early 2000s and adopted by Bay jurisdictions in 2005.



Designated Uses for Bay Tidal Waters

Designated Use	Criteria Concentration/Duration	Temporal Application
Migratory fish spawning and nursery	7-day mean 6 mg/l (tidal habitats with 0-0.5 ppt salinity)	February 1 - May 31
	Instantaneous minimum 5 mg/l	
Open water ¹	30-day mean 5.5 mg/l (tidal habitats with 0-0.5 ppt salinity)	year-round ²
	30-day mean 5 mg/l (tidal habitats with > 0.5 ppt salinity)	
	7-day mean 4 mg/l	
	Instantaneous minimum 3.2 mg/l at temperatures < 29°C	
	Instantaneous minimum 4.3 mg/l at temperatures ≥ 29°C	
Deep water	30-day mean 3 mg/l	June 1 - September 30
	1-day mean 2.3 mg/l	
	Instantaneous minimum 1.7 mg/l	
Deep channel	Instantaneous minimum 1 mg/l	June 1 - September 30

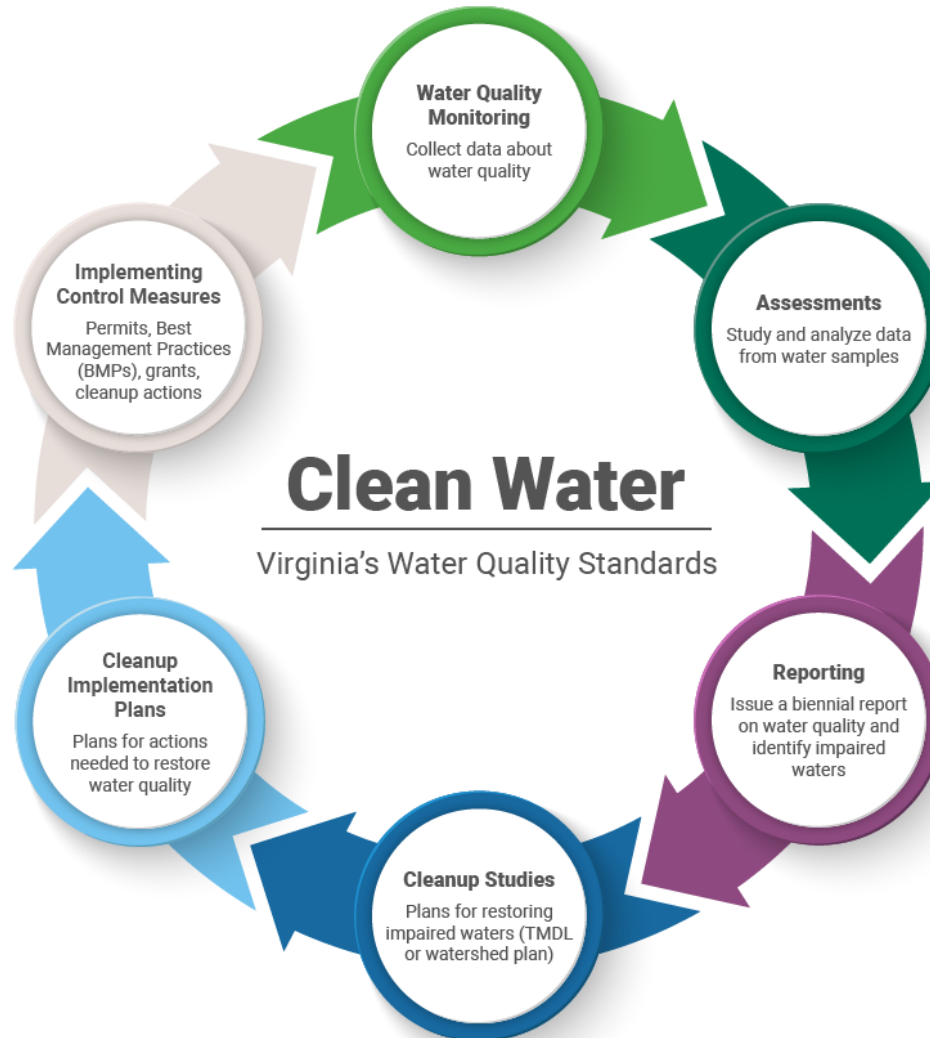
¹In applying this open water instantaneous criterion to the Chesapeake Bay and its tidal tributaries where the existing water quality for dissolved oxygen exceeds an instantaneous minimum of 3.2 mg/l, that higher water quality for dissolved oxygen shall be provided antidegradation protection in accordance with [9VAC25-260-30 A 2](#).

²Open-water dissolved oxygen criteria attainment is assessed separately over two time periods: summer (June 1- September 30) and nonsummer (October 1-May 31) months.

Criteria that are currently assessed by CBP

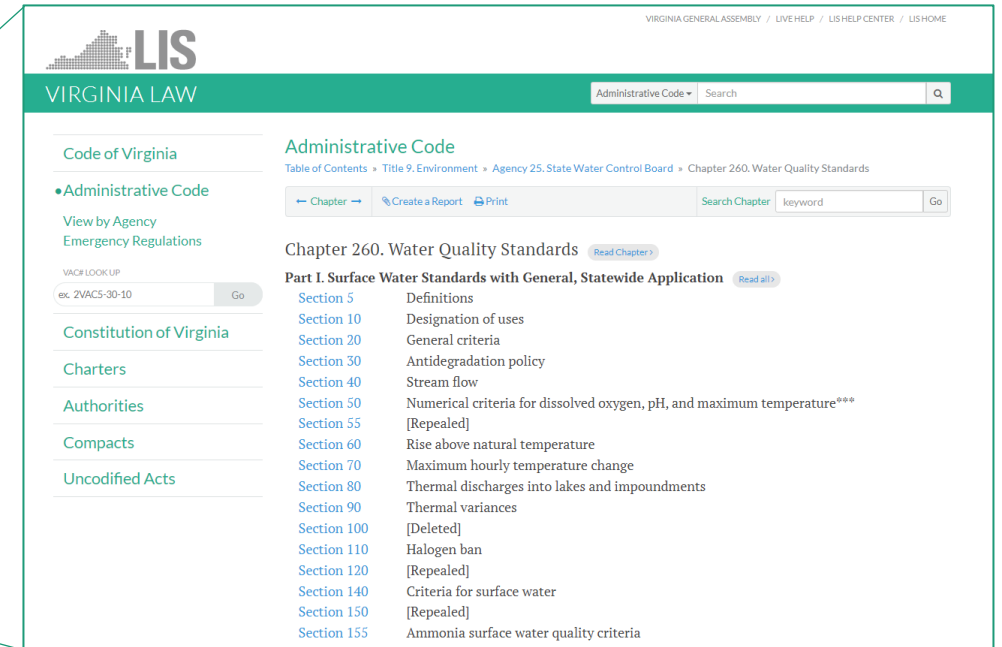
The Continuous Planning Process

DEQ's "Water Wheel"



The Continuous Planning Process

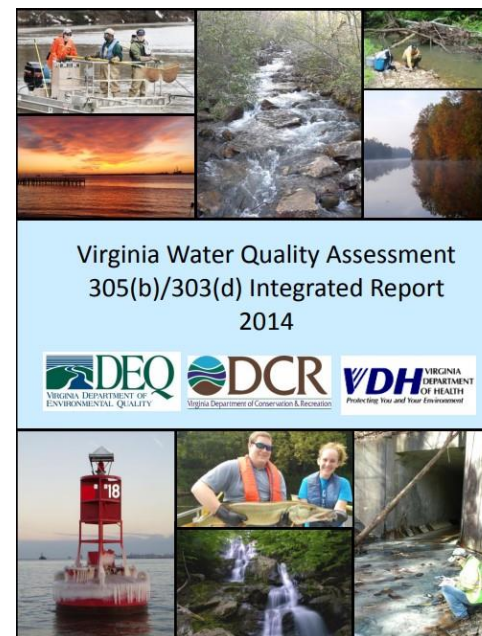
DEQ's "Water Wheel"



The Water Quality Standards are regulation in Virginia.

The Continuous Planning Process

DEQ's "Water Wheel"

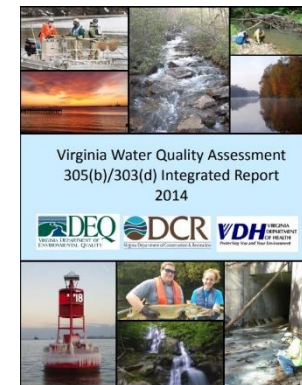


The Continuous Planning Process

DEQ's "Water Wheel"



DEQ performs and publishes criteria assessments every two years.



DEQ has been taking a look at the Bay DO assessment methodology



- The Bay DO assessment methodology for the currently assessed criteria has not been updated since 2010.
- A question that was brought up last year in a CAP workgroup meeting: “Should we consider rounding when calculating nonattainment rates?”
- The CAP workgroup was informed that the CBP does not perform rounding in its DO criteria assessments.

DEQ considers rounding to be an essential step in criteria assessment

- Virginia's water quality standards regulation and DEQ water quality program guidance require compliance/assessment data to be rounded to the number of significant figures of the threshold being implemented.
- DEQ believes that evaluating data with respect to significant figures is consistent with the best practices of data science, applied chemistry, and regulatory science.

Bay DO criteria recommended by EPA in 2003 and adopted by Virginia in 2005

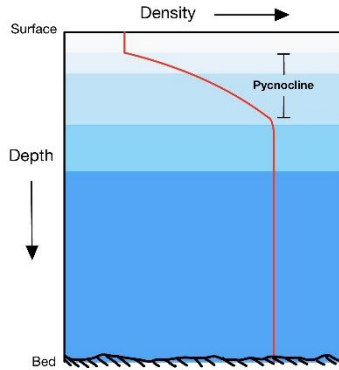
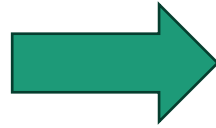
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 One sig fig
 Two sig figs

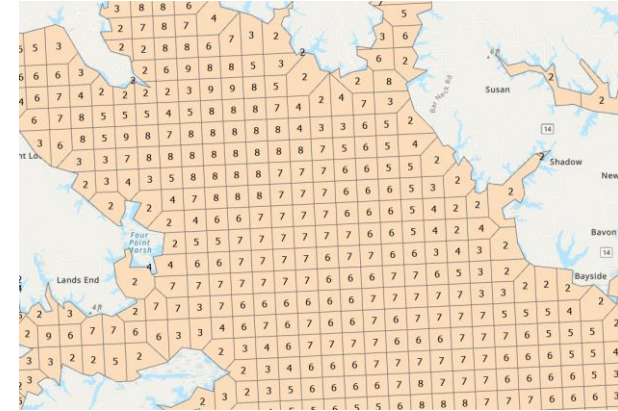
General Overview of Bay DO Assessment Methodology



Compile three years of DO, temp, and salinity data

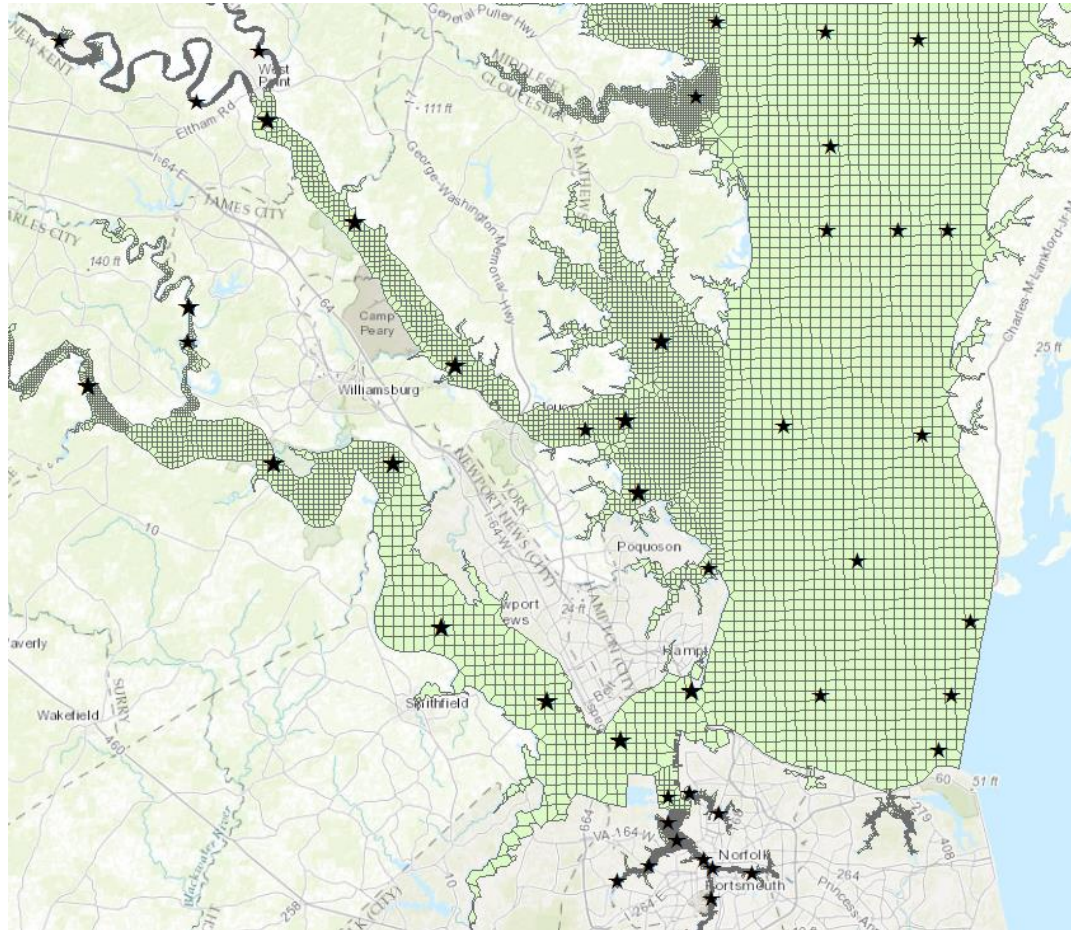


Calculate lower and upper pycnocline depths for each event



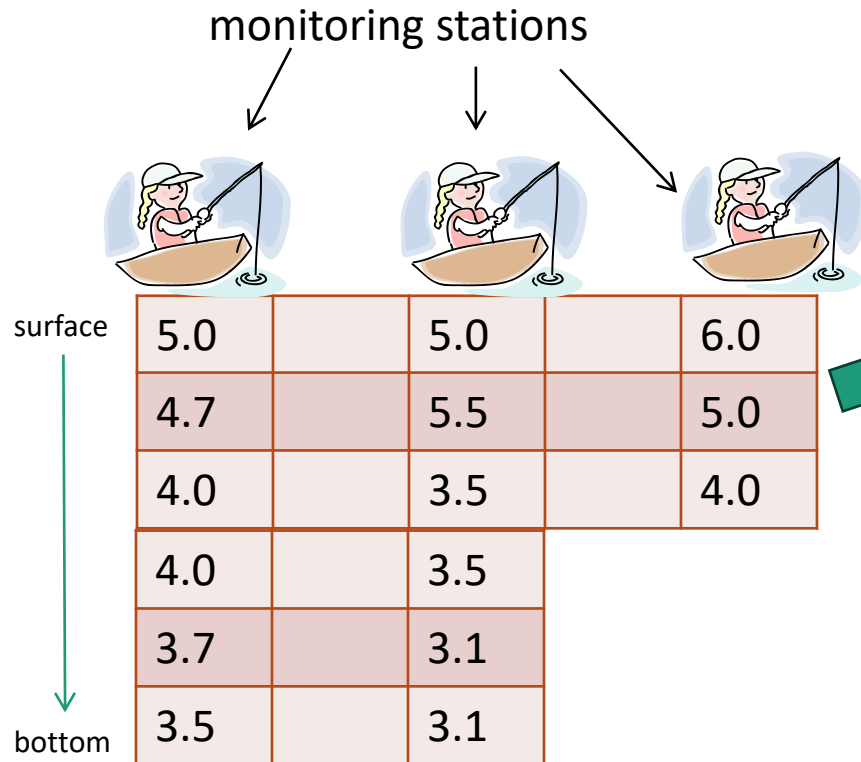
Spatially interpolate DO, salinity, and pycnocline depths

The Bay Interpolator Grid (2-dimensions are shown here, but it's actually 3-D)



★ Monitoring station

Spatial Interpolation



3D Interpolator

5.00	5.00	5.00	5.50	6.00
4.70	5.10	5.50	5.25	5.00
4.00	3.75	3.50	3.75	4.00
4.00	3.75	3.50		
3.70	3.40	3.10		
3.50	3.30	3.10		

Average with additional interpolated cruise data generated in the same month-year

5.21	5.01	5.06	5.51	6.25
4.95	5.15	5.59	5.26	5.07
4.33	3.77	3.59	3.78	4.39
4.15	3.75	3.50		
3.79	3.63	3.11		
3.50	3.56	3.10		

30-Day Mean criterion assessment values for a specific segment-month-year

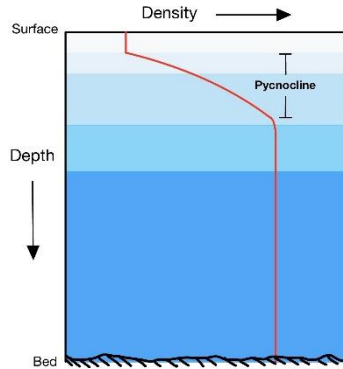
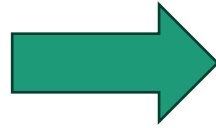
Hypothetical Segment (Cross-Section)

General Overview of Bay DO Assessment Methodology

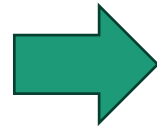


Compile three years of DO, temp, and salinity data

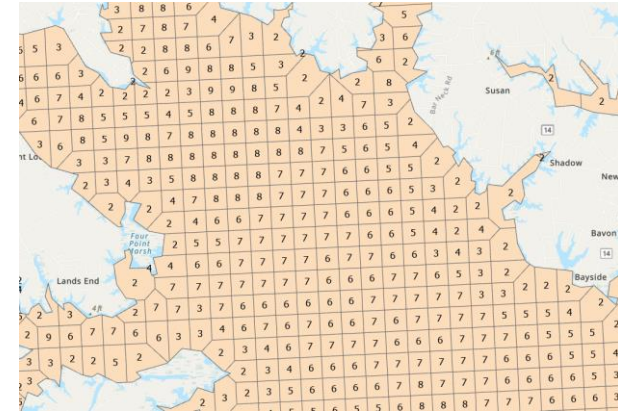
For 30-day mean criteria, average interpolation grids by month-year



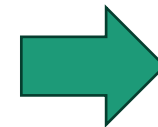
Calculate lower and upper pycnocline depths for each event



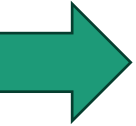
For each segment and DU, count the number of criteria exceedances. Divide by total number of grid cells to get spatial exceedance frequency.



Spatially interpolate DO, salinity, and pycnocline depths



Develop a CFD. Compare assessment CFD to reference curve.



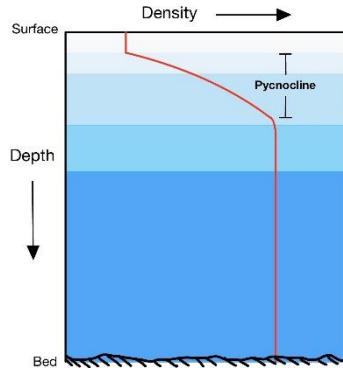
DEQ has written an R script that runs the Bay DO assessment

DEQ's assessment code follows the same basic procedural steps as the Bay Program's, but with one key difference...

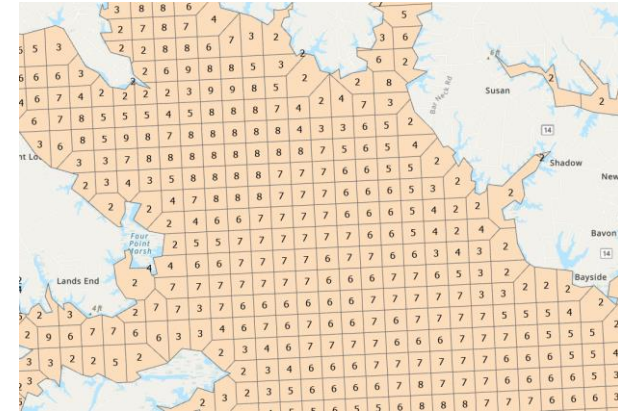
DEQ-modified Bay DO Assessment Methodology



Compile three years of DO, temp, and salinity data



Calculate lower and upper pycnocline depths for each event



Spatially interpolate DO, temp, salinity, and pycnocline depths

For 30-day mean criteria, average interpolation grids by month-year

Round assessment values to the number of sig figs of the applicable criterion

For each segment and DU, count the number of criteria exceedances. Divide by total number of grid cells to get spatial exceedance frequency.

Develop a CFD. Compare assessment CFD to reference curve.

DEQ's Plans Going Forward in the Near Term

- DEQ's Bay DO assessment results for the 2020-2022 period may be published as early as April 2024 in the 2024 Water Quality Assessment Integrated Report (IR).
- DEQ anticipates conducting future DO assessments in-house
- DEQ will continue to work with the CBP-Partnership on assessment tools and methodologies, including the development of the 4-D Interpolator.

Issues to Consider with development of the 4-D Interpolator

- Criteria significant figures
- Where to apply rounding in the analysis when determining what is an exceedance a criterion.
- Virginia's existing water quality standards are intentional with regard to significant figures, consistent with EPA's recommendations.
 - An alteration to Bay DO criteria precision would necessitate a rulemaking, as this would constitute an adjustment to the magnitudes of the criteria. It would not be a procedural change.

Questions?